Limited Visual Dam Safety Inspections

HI00042

Puukapu Reservoir

Hawaii, Hawaii

Prepared by:

U.S. ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

May 2006

Dam ID: HI00042
Name: Puukapu Reservoir

Limited Visual Dam Safety Inspection Conducted on: 6 April 2006

I. Purpose:

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections were authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statues, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections were conducted under joint agreements of the U.S. Army Corps of Engineers (ACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection was performed on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works included the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may or may not have appeared to be any immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

V. Inspection Team

Organization	Name
U.S. Army Corps of Engineers	Joseph P. Koester
State of Hawaii, Dept. of Land and Natural Resources	Eric Tanaka
National Resources Conservation Service	Drew Stout

VI. Owner's Representatives Present

Ernest Alfonso, State of Hawaii, Dept. of Agriculture

VII. Summary Report Team

Organization	Name
U.S. Army Corps of Engineers	Derek Chow
	Mr. Joseph Koester
State of Hawaii, Dept. of Land and Natural Resources	Denise Manuel
	Edwin Matsuda

VIII. Dam Type

The dam is an earthen embankment.

IX. Dam Classification

The current hazard classification of this dam is: High
Based on available data, this classification is believed to still be applicable.

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Small (42 ft height, but only 176 acre-feet storage)

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

Dam ID: HI00042
Name: Puukapu Reservoir

X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally described the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

A. General appearance:

The reservoir and dam features were easily recognizable. The dam appears to have a small drainage area.

Modifications / Improvements: There were no signs of any recent modifications.
Based on topography, offsite drainage is overland.
Based on staff personnel, this reservoir is not subject to flash flood conditions.
Based on staff personnel, this reservoir has no incident history.

Findings and Corrective Actions:

a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
b. An EAP is required for all High Hazard Dams. Submit an updated EAP for this facility.
c. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
d. Routine inspection logs were not inspected.
e. Dam owners shall provide for routine inspection of the dam.
f. Access to site appears to be satisfactory.
g. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
h. Power / Communication: There were no communication systems observed on this reservoir. There were no utility or power poles visible nearby.

B. Access / Security:

Access to the dam was accomplished via a County roadway.
A four wheel drive vehicle is not required to access the site, however, toe access is overland in rough, grassed pasture.

Any security issues. Valves are locked. Access to the dam is via several locked or lockable gates.

C. Inflow Works:

The inflow works consists of a 30-inch diameter steel pipe, diverting flow from the Upper Hamakua Ditch, which is roughly 3 ft wide and concrete lined. At the reservoir rim, inflow passes over a weir and through a short section of concrete open channel. The intake or inlets have the ability to be shut off or diverted away from the reservoir during periods of heavy rains. This is done manually.

Findings and Corrective Actions:

a. The intake works were not tested.
b. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.

D. Reservoir

The reservoir level during the inspection was 55 ft depth, based on maintenance of the pool within the lined basin and gage marks on the liner.
According to staff personnel, the reservoir is normally operated at this depth, and the spillway is always flowing.
No sinkholes or depressions were observed.

Findings and Corrective Actions:

a. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.

E. Upstream Slope (Satisfactory)

The upstream slope was approximately 1-1/2 H: 1V to 3 H: 1V (Horizontal/Vertical).
Slope protection apparently consists of a concrete liner for approximately two-thirds of the circumference of the reservoir rim, and the remaining third is covered with dumped rock.
No vegetation was observed growing between the rocks.
No major erosions were observed, nor were cracks or sinkholes.

Findings and Corrective Actions:

a. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
b. A small amount of erosion is occurring at the junction between the concrete liner and the rock slope. This point is found about 50 ft from the outlet control stem, proceeding clockwise around the rim. This erosion does not appear to be recent or progressive, but should be inspected at regular periodic inspection intervals.

F. Crest: (Satisfactory)

The dam crest was approximately 20 feet wide. There was a dirt access road on top of the crest that appeared to be well utilized. Only low ground cover vegetation was observed on the crest.

Findings and Corrective Actions:

a. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
b. Access along the crest was satisfactory.

G. Downstream Slope: (Fair)

The downstream slope was in poor condition and not visible due to heavy vegetation. The slope was very steep, around a 1-1/2 H to 1V slope. The downstream slope was accessed by overland driving in a pasture; there is no roadway along the downstream toe. Slope protection observed on the downstream slope consists of grass and low bushes, except on the tallest quarter of the embankment. In this region, the slope is covered with dumped rock at apparent repose angle, and numerous ferns and larger woody vegetation is growing through the rock. Erosion was not observed on the downstream slope, however the slope was not entirely visible. Vegetation was observed on the downstream slope, as mentioned. The majority of the vegetation was large bushes and small trees, ranging from 3 to 6 inches in diameter. Seepage was observed on the downstream slope, however the slope was not entirely visible to enable precise location of the exit. The more heavily vegetated area obscures the source of the clear seep, which trickles audibly through the dumped rock.

Findings and Corrective Actions:

a. The downstream slope appeared to be in fair condition and requires corrective action.
b. Slope protection does not require immediate maintenance or repair, but heavy brush should be removed to expose the slope for inspection.
c. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
d. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2” diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
e. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition. Seeping water appears clear, with some iron staining of the surface. Flow rate was indeterminate due to dispersed flow. Conduct dye study to isolate flaw in reservoir lining.
f. The slope was very steep, around a 1-1/2 H to 1V slope; as a result of the seepage in the tallest portion of the slope, further study is recommended to verify slope stability. There was no sliding or heave evident from the visual inspection.

H. Abutments / Toe: (Fair)

The toe was not entirely visible or identifiable due to heavy vegetative growth. Erosion along the abutment or toe was not observed.
Areas were noted along the toe that could be possible seepage spots (see discussion on downstream slope, above). These locations were observed downslope from the junction between concrete and dumped rock reservoir lining. The water that was seeping appeared to be moving relatively slowly, without moving soil materials.

Findings and Corrective Actions:

a. The abutments/toe appeared to be in fair condition and requires corrective action.
b. Slope protection needs maintenance or repair. Description: Removal of brush, locate seep.
c. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
d. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
e. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

I. Outlet Works: (Satisfactory)

Not inspected in detail, not tested. The outlet works were not visible, but the owner representative stated that it consists of a 24" ductile iron pipe. The outlet works was controlled via a gate valve on the upstream side of the dam.

Findings and Corrective Actions:

a. The outlet works were not tested.
b. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

J. Spillway: (Satisfactory)

This spillway consisted of a 6 ft wide, 8 ft deep reinforced concrete channel. The spillway channel then feeds a drainage swale that runs along the base of the downstream toe, toward the right embankment and then head downstream. The spillway approach was clear. There was no erosion observed near the spillway.

Findings and Corrective Actions:

a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.

K. Down Stream Channel: (Satisfactory)
There is a well-defined downstream channel, consisting of an unnamed paved ditch. This reservoir is considered to have a high hazard potential.

Findings and Corrective Actions:
a. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.

XI. Additional Comments:

Chain link exclusion fencing is in disrepair. Galvanized posts at several locations have corroded to the extent that they are missing half of their original shape from the windward side. Fence collapse is imminent unless the damaged posts are replaced, which would open the reservoir to uncontrolled human and animal visits. Steep, smoothly lined slopes inside the reservoir present a drowning hazard to any person or animal that falls in.

Original field inspection notes were scanned and are attached to this summary report. Included are several photos from the site visit to detail important features of the project, captioned to be self-explanatory.

Per e-mail dated 5/1/2006 12:57 pm from Joe Koester, USACE.

Other studies conducted? Unknown
Reservoir: Normal Operating Level/Range
Lined reservoir kept full; approximately 55 ft deep at center Range not applicable. Gage measurement is provided by markings on the liner; additional gage data are available from the inlet and outlet works, by means of weir depth.
Ditch/Flume:
The size is 3' by __6_ feet.
What does the arrow indicate? Was it the pipe that was not inspected? The arrow intended to state that the works were not tested. Controls were located inside a building that was not entered.
Upstream slope: If settlement/erosion was observed, shouldn't the top portion indicate it? Also, if there was small settlement/erosion, would it change the findings to be in fair to poor condition?
The observed discontinuity in slope at the change between concrete and dumped rock lining was not substantial; may not represent a change over time from original construction. I would not change my condition rating.
Outlet works:
No seepage observed connected with outlet works. Only seep observed was on tallest portion of downstream slope as detailed.
Spillway Slope protection: Spillway is concrete channel
Comments:
I do not believe the seep poses an immediate threat to the safety of the dam. I recommend a dye or similar study to locate and repair the leak in the lining of the reservoir, but this is not a safety issue.

PHOTOGRAPHS

Dam ID: HA-042
Name: Puukapu Reservoir

Aerial view of Puukapu Reservoir (HA-042)

Inflow control structure, diverting water from Upper Hamakua Ditch (HA-042)

Dam ID: HA-042
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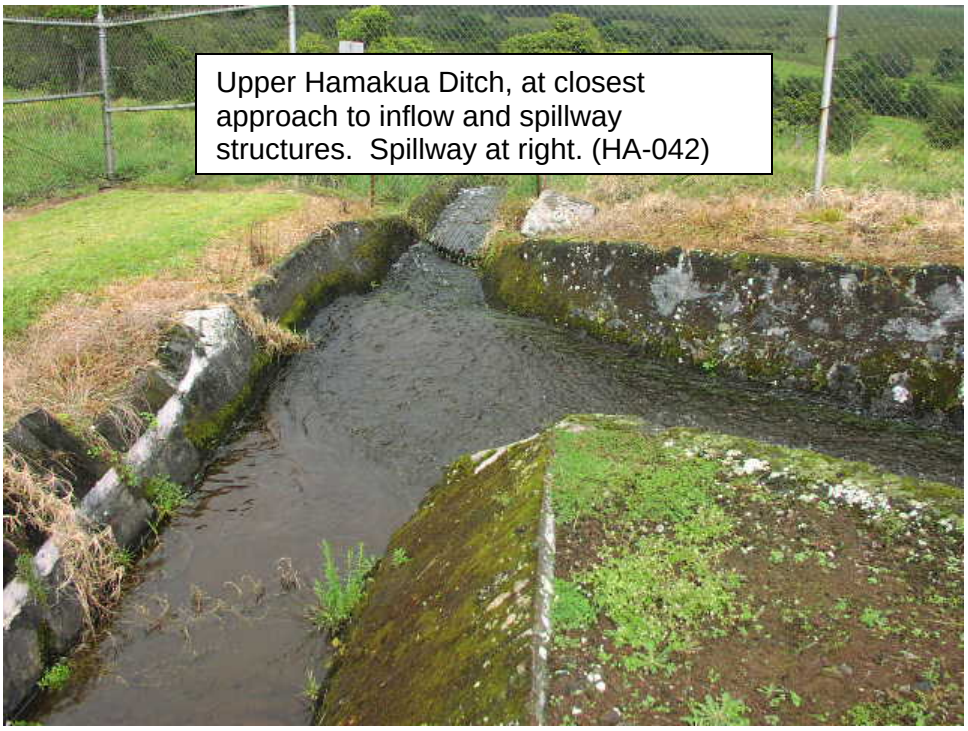
Inflow weir, viewed from reservoir side (HA-042)

Spillway channel at inlet, showing gate valve control (HA-042)

Dam ID: HA-042
Name: Puukapu Reservoir



Upper Hamakua Ditch, at closest approach to inflow and spillway structures. Spillway at right. (HA-042)

Junction between concrete and dumped rock lining (1 of 2). Outlet control stem at background right; inflow and spillway visible at background left (HA-042)

Dam ID: HA-042
Name: Puukapu Reservoir

Downstream slope below outlet. Trees are growing in seep area. Slope is dumped rock covered by grass (HA-042)

View looking upslope from seep (red paint marks area of flow) (HA-042)

Dam ID: HA-042
Name: Puukapu Reservoir

Upper Hamakua Ditch structure below outlet and seep area (HA-042)

FIELD INSPECTION SHEETS

Dam ID: HA-0042
Puukapu Reservoir
(Waimea 60MG Reservoir)

Vulnerability Index:
Extreme 1 | High 2 | Moderate 3 | Low 4

Inspection No:
Date: 4/6/06

STATE OF HAWAII - DLNR
DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present	Affiliation	Phone Number
Joe Kuester	US Army Corps of Engineers	
Dean Stout	NRCS	
Eric Tanaka	DLNR	
Ernest Alfonso	DOA	

Weather Condition: ☐ Rain previous day ☐ Rainy ☑ Drizzle / Mist ☐ Cloudy/Overcast ☐ Partly Cloudy ☐ Sunny ☐ Dry

Comments:

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1. General: *(Information currently on file, update as required)*

Dam/Res. Name: Puukapu Reservoir (Waimea 60 MG Reservoir)
Owner: State of Hawaii, Department of Agriculture *(C027)*
Owner Contact: Mr. Brian Kau — Owner Ph.:
Lessee: N/A — Lessee Ph.:
O & M Contractor: Department of Agriculture — O & M Ph.:
Nearest Town: WAIMEA — Latitude: 20.05 ° (decimal)
County: HAWAII — Longitude: 155.6267 ° (decimal)
Tax Map Key(s):

Dam Status	A:	Hazard Potential	H:	Dam Size	
Year Completed	1957	Dam Length	1070 ft.	Dam Height	42 ft.
Normal Storage	176 ac.ft.	Max. Storage	189 ac.ft.	Max. Surface Area	ac.
Drainage Area	mi.	Spillway Type		Max. Spillway Q	cfs

Owner owns land under dam facility:
Emergency Action Plan on file with the Department: NO
Reports on file with the Department: July 1996 = Dam Safety Inspection, Woodward Clyde (7)

Dam ID: HA-0042
Puukapu Reservoir

Inspection No: _____
Date: 4/6/06

2. Questions for Owner's Rep.:

	Yes	No	Unknown	Comments
Construction Plans Available	☑	☐	☐	
Site / Facility Map	☑	☐	☐	
Operation & Maintenance Manual	☐	☐	☑	
Emergency Action Plan	☐	☐	☑	
Modifications / Improvements	☐	☑	☐	
Conduct Routine Inspections	☑	☐	☐	
Conduct Routine Maintenance	☑	☐	☐	
Vehicle access to site	☑	☐	☐	☐ Not accessible ☑ With Standard car ☐ Requires 4-Wheel Drive
Access during heavy rains	☑	☐	☐	☐ Not accessible ☑ With Standard car ☐ Requires 4-Wheel Drive
Access when spillway is flowing	☑	☐	☐	☐ Not accessible ☑ With Standard car ☐ Requires 4-Wheel Drive
Other Studies Conducted	☐	☐	☐	☐ Phase I ☐ Phase II ☐ Hydraulics ☐ Stability ☐ Hazard ☐ Seismic ☐ Other: _____
Incident History	☐	☑	☐	☐ Breached ☐ Overtop ☐ Slide ☐ Down stream Flooding ☐ Other: _____
Reservoir's Current Use	☐	☐	☐	☐ Sediment ☑ Irrigation ☐ Recreation ☐ Flood Control ☐ Drinking Water ☐ Power Generation ☐ Other: _____

Findings and Corrective Actions:

- ☑ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☑ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- ☐ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☐ f. Routine inspection logs were not inspected.
- ☐ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☑ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☐ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☐ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. _____

Additional Requirements:

The following investigative study(s) are:

Required	Recommended	
☐	☐	Phase I Study
☐	☐	Phase II Study (Including ☐ Seepage ☐ Hydrology/Hydraulics ☐ EAP)
☐	☐	Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity)
☐	☐	Stability Analysis
☐	☐	Seismic Analysis
☐	☐	Hazard Classification
☐	☐	Other: _____

Dam ID: HA-0042
Puukapu Reservoir

Inspection No: _____
Date: 4/6/06

Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir:

Level during inspection 55' DEEP ft per ___ (gage / other)

Normal Operating Level/Range SOME ft per _____ (gage / other)

Description: _____

Typical Operation ☐ Spillway always flowing ☑ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms

☐ Other: _____

Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☐ Not Visible ☑ None Observed

Description: _____

Staff Gage: Description: _____

Findings:

☐ a. The reservoir was not inspected.
☑ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☐ e. The staff gage needs maintenance and/or repair. Description: _____
☐ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
☐ h. _____

4. Intake Works Description:

☐ Number of Intakes 1

☑ Intake Culvert / Pipe

Size: 30" in. ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☑ Other STEEL

Control: ☐ Gate ☐ Valve ☑ Flow can either be Shut off or Bypassed

From: ☑ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

☑ Ditch / Flume

Dimension: 3' (Size x Depth) Shape BOX

Surface: ☐ Dirt ☐ Wood ☑ Concrete ☐ Lined w/ _____

Control: ☐ Gate ☐ Valve ☑ Flow can either be Shut off or Bypassed

From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other UPPER NAMAKAA DITCH

Findings:

☑ a. The intake works were not inspected.
☑ b. The intake works were not tested.
☐ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☐ f. The intake works needs maintenance and/or repair. Description: _____
☐ g. _____

Dam ID: HA-0042
Puukapu Reservoir

Inspection No:
Date: 4/6/02

5. Upstream Slope: **(Typical Slope ± 1/2 H : 1 V)**

Slope Protection: ☐ None ☑ Dumped Rock ☑ Fitted Rip Rap ☑ Grouted Rip Rap ☐ Liner _____ ☑ Other: CONCRETE
☐ Defect in Protection: Description: 2/3 CONCRETE, 1/3 ROCK

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☑ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed
Description: _____

Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☐ Not Visible ☑ None Observed
Description: _____

Vegetation: ☑ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Findings:

☐ a. The upstream slope was not inspected.
☑ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.
☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Slope protection needs maintenance or repair. Description: _____
☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☑ k. SMALL EROSION/SETTLEMENT AT JUNCTION OF CONCRETE AND ROCK SLOPES, 50' FROM OUTLET SYSTEM

Dam ID: HA-0042
Puukapu Reservoir

Inspection No: _____
Date: 4/6/06

6. Crest: Approximate Crest Width: 20'

Access: ☐ None ☐ Walking Path ☑ Roadway, Surface / Width / Usage: UNPAVED

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☑ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed
Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☑ None Observed
Description: _____

Vegetation: ☐ None ☑ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Findings:

- ☐ a. The dam crest was not inspected.
- ☑ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☑ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: _____
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: _____
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. _____

Dam ID: HA-0042
Puukapu Reservoir

Inspection No: _____
Date: 4/6/86

7. Downstream Slope: (Typical Slope ± 1½H : 1V)

Access: ☐ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☑ None Observed

Slope Protection: ☐ None ☑ Dumped Rock * ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☑ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☑ None Observed

Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☑ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: FERNS AND WOODY VEGETATION IN SEEP AREA

Seepage:

Seep Spot Number 1

☑ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☑ Flowing, Description: CLEAR, AUDIBLE TRICKLING; OUTLET NOT ISOLATED, DIRECT DOWNHILL FROM ROCK/CONCRETE LINER JOINT

Water Clarity: ☑ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

ROCK EXCAVATED FROM RESERVOIR DUMPED ON TOE OF D.S. SLOPE

Description: _____

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

- ☐ a. The downstream slope was not inspected.
- ☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☑ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☑ e. Slope protection needs maintenance or repair. Description: REMOVAL OF WOODY BRUSH (OBSCURES SEEP OUTLET)
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☑ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection. IN SEEP AREA
- ☑ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☑ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition. DYE STUDY RECOMMENDED
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
- ☑ k. ROCK BUTTRESSES SLOPE IN SEEP AREA, STABILITY NOT LIKELY THREATENED

Dam ID: HA-0042
Puukapu Reservoir

Inspection No:
Date: 4/6/06

8. Abutments/Toe:

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☑ None Observed
Description:

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed
Description:

Vegetation: ☐ None ☐ Low Ground Cover ☑ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description:

Seepage: Seep Spot Number 1 SEE SLOPE COMMENTS
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description:
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other:
Description:

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description:
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other:
Description:

Findings:

☐ a. The abutments/toe were not inspected.
☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
☑ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☑ e. Slope protection needs maintenance or repair. Description: REMOVAL OF BRUSH, LOCATE SEEPS
☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair. Description:
☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☑ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☑ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☑ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
☐ l. _____

Dam ID: HA-0042
Puukapu Reservoir

Inspection No:
Date: 4/6/06

9. Outlet Works:

Culvert / Pipe

Type / Size: 24"

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☑ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control Type: ☐ Gate ☑ Valve ☐ Other _____

Location: ☑ Control on Upstream side ☐ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

☐ a. The outlet works were not inspected.

☑ b. The outlet works were not tested.

☑ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.

☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.

☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☐ i. _____

☐ j. _____

Dam ID: HA-0042
Puukapu Reservoir

Inspection No:
Date: 4/6/06

10. Spillway:

Type: ☐ None ☐ Culvert/Pipe ☑ Channel

Description: CONCRETE, RECTANGULAR, WEIR; 6' WIDE, 8' DEEP

Dimension: SEE ABOVE ft. Invert elevation: _____ ft. per staff gage ?

Slope Protection: ☐ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☑ Concrete

☐ Defect in Protection: Description: _____

Approach: ☑ Clear ☐ High Veg. ☐ Trees ☐ Other: _____

Erosion: ☐ Scour ☐ Gully ☐ Headcut ☑ Not Observed ☐ Other: _____

Description: _____

Vegetation: ☑ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Findings:

☑ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.

☐ b. The Spillway appeared to be in fair to poor condition and requires corrective action.

☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ d. Slope protection needs maintenance or repair. Description: _____

☐ e. The spillway approach was blocked. Clear approach.

☐ f. Severe scour erosion was observed which requires maintenance and/or repair.
Description: _____

☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.

☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.

☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.

☐ j. _____

11. Down Stream Channel:

Name: PAVKO DITCH

Downstream: ☐ Sump ☐ Open Area ☑ Un-Defined Drainage-way ☐ Defined Drainage-way ☐ Other _____

Items along Stream Bank: ☐ None ☐ Road ☐ Houses ☐ Town ☑ Not Inspected

Description: _____

Findings:

☐ a. The downstream channel was not inspected.

☑ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.

☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.

☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. _____

Dam ID: HA-0042 Puukapu Reservoir	Inspection No: _____ Date: 4/6/06

Additional Comments:

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

FENCE POST SHOULD BE REPLACED WHERE BADLY CORRODED, ALONG WESTERN BOUNDARY

ACTIVE, LONG TERM SEEP RUNNING, RATE NOT MEASURED (TOO DISPERSED) ~~BELOW TOE~~ FROM BOTTOM THIRD OF EASTERN SLOPE. THIS IS D.S. OF THE TRANSITION FROM CONCRETE TO ROCK LINING NEAR OUTLET. AREA IS COVERED WITH ROCK BURDEN REMOVED DURING EXCAVATION OF RESERVOIR. DOES NOT APPEAR TO THREATEN SLOPE STABILITY; ROCK SLOPE IS FREE-DRAINING AND MAY ACT AS STABILITY BERM. RECOMMEND DYE STUDY TO DETERMINE SOURCE IN RESERVOIR.

Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statures Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003